

FORM PTO-1390
(REV. 12-2001)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371

P.19463/MAJR

U.S. APPLICATION NO. (If known, see 37 CFR 1.5

10/069120

INTERNATIONAL APPLICATION NO.

INTERNATIONAL FILING DATE

PRIORITY DATE CLAIMED

PCT/ZA00/00155

31 August 2000 (31.08.00)

01 September 1999 (1.09.99)

TITLE OF INVENTION

Base Metal Recovery From a Tailings Dump by Bacterial Oxidation

APPLICANT(S) FOR DO/EO/US CRAVEN, Peter Michael, et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☐ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
 - a. ☐ is attached hereto (required only if not communicated by the International Bureau).
 - b. ☒ has been communicated by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
 - a. ☐ is attached hereto.
 - b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
 - a. ☐ are attached hereto (required only if not communicated by the International Bureau).
 - b. ☐ have been communicated by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). Unexecuted Declaration
10. ☐ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 20 below concern document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A **FIRST** preliminary amendment.
14. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
15. ☐ A substitute specification.
16. ☐ A change of power of attorney and/or address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
18. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. ☒ Other items or information:

a) PCT Published Application WO 01/16385 published 8 March 2001

b) International Search Report dated Jan. 19, 2001

c) International Preliminary Examination Report mailed Nov 22, 2001

U.S. APPLICATION NO.

10/069120

INTERNATIONAL APPLICATION NO.

PCT/ZA00/00155

ATTORNEY'S DOCKET NUMBER

P.19463/MAJR

21. ☒ The following fees are submitted:

CALCULATIONS PTO USE ONLY

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1)-(5)):

Neither international preliminary examination fee (37 CFR 1.482)
nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO
and International Search Report not prepared by the EPO or JPO \$1040.00

International preliminary examination fee (37 CFR 1.482) not paid to
USPTO but International Search Report prepared by the EPO or JPO \$890.00

International preliminary examination fee (37 CFR 1.482) not paid to USPTO
but international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$740.00

International preliminary examination fee (37 CFR 1.482) paid to USPTO
but all claims did not satisfy provisions of PCT Article 33(I)-(4) \$710.00

International preliminary examination fee (37 CFR 1.482) paid to USPTO
and all claims satisfied provisions of PCT Article 33(I)-(4) \$100.00

ENTER APPROPRIATE BASIC FEE AMOUNT =

\$ 890.00

Surcharge of \$130.00 for furnishing the oath or declaration later than ☐ 20 ☒ 30
months from the earliest claimed priority date (37 CFR 1.492(e)).

\$ 130.00

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	\$
Total claims	11 - 20 =	0	x \$18.00	\$ 0.00
Independent claims	2 - 3 =	0	x \$84.00	\$ 0.00
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ \$280.00	\$ 0.00

TOTAL OF ABOVE CALCULATIONS = \$ 1,020.00

☐ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above
are reduced by 1/2. + \$ 0.00

SUBTOTAL = \$ 1,020.00

Processing fee of \$130.00 for furnishing the English translation later than ☐ 20 ☐ 30
months from the earliest claimed priority date (37 CFR 1.492(f)). \$ 0.00

TOTAL NATIONAL FEE = \$ 1,020.00

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be
accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property + \$ 0.00

TOTAL FEES ENCLOSED = \$ 1,020.00

Amount to be
refunded: \$

charged: \$

- a. ☒ A check in the amount of \$ 1,020.00 to cover the above fees is enclosed.
- b. ☐ Please charge my Deposit Account No. _____ in the amount of \$ _____ to cover the above fees.
A duplicate copy of this sheet is enclosed.
- c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any
overpayment to Deposit Account No. 10-1213 A duplicate copy of this sheet is enclosed.
- d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card
information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR
1.137 (a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Jennifer P. Yancy
Jones, Tullar & Cooper, P.C.
P.O. Box 2266
Eads Station
Arlington, VA 22202

Jennifer P. Yancy
SIGNATURE

Jennifer P. Yancy

NAME

47,003

REGISTRATION NUMBER

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:)
CRAVEN, et al.) Atty. Docket No. P.19463/MAJR
Application No.: TBA)
Filed: March 1, 2002)
For: BASE METAL RECOVERY FROM)
A TAILINGS DUMP BY BACTERIAL)
OXIDATION)

PRELIMINARY AMENDMENT

Assistant Commissioner of Patents
Washington, DC 20231

Sir:

This is a Preliminary Amendment in the application filed herewith under 35 U.S.C. 371:

Please amend the above-identified application as follows:

IN THE SPECIFICATIONS:

Page 1, before the first line, the following is inserted:

-- Cross-reference to Related Application

This is a filing under 35 U.S.C. 371 of PCT/ZA00/00155, filed 31 August 2000, which claims priority from South African Application No. 99/4274, filed 01 September 1999. PCT/ZA00/00155 has been published under No. WO 01/16385, and the publication is in English. --

IN THE CLAIMS:

Please cancel claims 1-15, all of the claims set forth in the specification, without prejudice.

Please add new claims 16-26, as follows:

16. A method of recovering base metal from a tailings dump which includes the steps of:
- (a) aerating a surface layer of the dump by agitating or mechanically loosening the surface layer;
 - (b) providing conditions favourable for bacterial oxidation of sulphide minerals by:
 - (1) adjusting the pH of the surface layer to a level in the range of from 1.3 to 2.0, and
 - (2) adjusting the moisture content of the surface layer to a value of from 16% to 20%;
 - (c) allowing bacterial oxidation to take place for a controlled period resulting in a oxidised surface layer;
 - (d) removing the oxidised surface layer after the controlled period and adding water thereto to form a slurry;
 - (e) separating the slurry into solids and a solution; and
 - (f) recovering base metal from the solution.

17. The method according to claim 1 wherein the surface layer is aerated by ploughing the surface layer to a depth of between 0.5 to 1.0 metres.

18. The method according to claim 1 wherein the pH is adjusted by adding sulphuric acid to the surface layer.

19. The method according to claim 1 wherein the said controlled period, in step (c), is at least four weeks.

20. The method according to claims 1 wherein the oxidised surface layer is removed by mechanical means or by the use of water jets.

21. The method according to claim 1 wherein the slurry is directed to at least one tank in which agitation of the slurry takes place.

22. The method according to claim 1 wherein base metal in sulphate form in solution is separated from the slurry.

23. The method according to claim 1 wherein step (f) is carried out using solvent extraction or ion exchange techniques.

24. The method according to claim 1 wherein said base metal is copper.

25. The method according to claim 24 wherein the tailings dump results from the grinding of copper ores followed by a flotation process.

26. A copper recovery process wherein copper ore is ground and then subjected to a flotation process which results in tailings which are transferred to a tailings pile, and wherein the tailings pile is subjected to the following:

- a) loosening and aerating of a surface layer of the pile;
- b) adjusting the pH of the surface layer to a value in the range of from 1.3 to 2.0;
- c) adjusting the moisture content of the pile to lie in a range of from 16% to 20%;
- d) allowing bacterial oxidation of at least sulphide minerals in the surface layer for a controlled period;
- e) removing the surface layer thereafter;
- f) mixing the surface layer with water to form a slurry which is conveyed to at least one agitation tank
- g) separating the slurry in the tank into solids and a solution from which copper is extracted using solvent extraction or ion exchange techniques.

IN THE ABSTRACT:

Please add the Abstract of the Disclosure as set forth on the separate accompanying sheet.

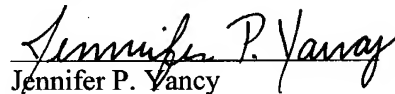
REMARKS

Original claims 1-15 have been canceled in favor of new claims 16-26. These newly presented claims are similar to the claims added to the PCT application and have been written in a form more in accordance with U.S. practice and eliminating multiply dependent claims.

A suitable Abstract of the Disclosure has been added. This is generally similar to the Abstract set forth in the published application WO 01/16385. No new matter is being added.

Entry of this Preliminary Amendment prior to the examination of the application on its merits, and prior to the calculation of the filing fee is respectfully requested.

Respectfully submitted,


Jennifer P. Vancy
Reg. No. 47,003

JONES, TULLAR & COOPER, P.C.
P.O. Box 2266 Eads Station
Arlington, VA 22202
(703) 415-1500
March 1, 2002

Attorney Docket No. P.19463/MAJR

ABSTRACT OF THE DISCLOSURE

A method of recovering base metal from a tailings dump which includes the steps of: aerating a surface layer of the dump; adjusting the pH and the moisture content of the surface layer to provide conditions favourable for bacterial oxidation of sulphide minerals; allowing bacterial oxidation to take place for a controlled period; after the controlled period removing the oxidized surface layer and adding water thereto for form a slurry; separating the slurry into solids and a solution; and recovering base metal from the solution.

11/PRTs

10/069120
JC19 Rec'd PCT/PTO 01 MAR 2002

BASE METAL RECOVERY FROM A TAILINGS DUMP BY BACTERIAL OXIDATION

BACKGROUND OF THE INVENTION

5

This invention relates to the recovery of base metals from tailings and is more particularly concerned with the oxidation of sulphide minerals in tailings dams or dumps.

10

A substantial amount of literature exists relating to the heap leaching of waste rock by natural oxidation through bacterial action. Oxidation of this type requires that air can freely penetrate the rock. This is usually the case for the rock is relatively coarse and the air can easily penetrate into the interior of a pile of rock. The bacteria are then capable of oxidising the sulphide minerals and the base metals may be dissolved by solution percolation through a rock pile.

15

If a tailings dump is formed from material with a fine particle size, for example with a particle size which is less than 100 microns, then the dump is normally naturally compacted and the ability of air to penetrate to the interior of the dump is at best restricted but more generally prevented.

20

Two publications have addressed the problem of bacterial leaching of tailings with fine particle size, i.e. slime, for the recovery of gold. Reference is made in this regard to:

25

1. Livesey-Goldblatt E. Bacterial leaching of gold, uranium, pyrite bearing compacted mine tailing slime. In: Lawrence RW, Branion RMR, Ebner GH, eds. Fundamental and Applied Biohydrometallurgy. New York: Elsevier, 1986:89-96;
2. Lawson EN, Taylor JL, Hulse GA. Biological pre-treatment for the recovery of gold from slime dams. Journal of South African Institute of Mining and Metallurgy, 1990;

Printed: 19-11-2001

DESCPAMD

00962051-ZA0000155

INT1004/MAJR

2

In the processes described in these publications oxidized minerals in the form of soluble iron and sulphate are dissolved. These processes are however principally directed to the recovery of gold.

- A publication entitled "Bacterial Leaching of Gold, Uranium, Pyrite Bearing Compacted Mine Tailing Slimes" (Database Compendex 'Online! Engineering Information, Inc., New York, NY, US; Livesey-Goldblatt Eric: "Bacterial Leaching of Gold, Uranium, Pyrite Bearing Compacted Mine Tailing Slimes" Database accession no. EIX88010014488, XP002156692 abstract) describes a process of loosening the compacted material to allow air and water penetration, and inoculation of the material with bacteria. EP-A-522978 describes precious metal recovery from a heap to which is added a bio-oxidation solution and a leaching solution. These documents do not however specifically address the problem of recovering base metals from tailings dams or dumps.

SUMMARY OF THE INVENTION

- The invention provides a method of recovering base metal from a tailings dump which includes the steps of:
- (a) aerating a surface layer of the dump by agitating or mechanically loosening the surface layer,
 - (b) providing conditions favourable for bacterial oxidation of sulphide minerals by:
 - (1) adjusting the pH of the surface layer to a level in the range of from 1,3 to 2,0, and
 - (2) adjusting the moisture content of the surface layer to a value of from 16% to 20%;

INT1004/MAJR

3

- (c) allowing bacterial oxidation to take place for a controlled period;
- (d) after the controlled period removing the oxidised surface layer and adding water thereto to form a slurry;
- (e) separating the slurry into solids and a solution; and
- 5 (f) recovering base metal from the solution.

The aforementioned method lends itself particularly to the recovery of copper from a tailings dump.

The aeration of the surface layer may be achieved in any appropriate manner for example by ploughing the surface layer to a required depth which may be of the order of
10 from 0,5 to 1,0 metres.

The pH of the surface layer may be adjusted by adding acid eg. sulphuric acid thereto. The pH may be brought to a level in the range of from 1,3 to 2,0.

The duration of the controlled period during which bacterial oxidation takes place should be sufficient to ensure that substantially all of the sulphide minerals are oxidized. The
15 duration of this period is dependent on physical conditions and on the nature of minerals. Thus, for example, the duration of the period may be temperature dependent and may also be affected by the depth of the surface layer, the degree of aeration which is achieved and the recovery figure which is being aimed at. Thus the duration of the controlled period may be at least four weeks.

20 The oxidized surface layer may be removed using any appropriate techniques. Thus the oxidized surface layer may be removed mechanically and water may then be added to the surface layer. One may also make use of water jets which are emitted by water

ATT 34 AMDT

INT1004/MAJR

3A

guns or the like and which washes the surface layer from the tailings dump. Additional water, or a suitable aqueous solution, may be added to the material which is washed away to form a slurry of a desired consistency.

The slurry may be agitated. This step may be carried out in a tank.

- 5 The base metal in sulphate form in solution may be separated from the slurry. The remaining solids may be washed to ensure effective recovery of the base metal sulphates.

5 Solids remaining after the separation step may be directed to waste.

The desired base metal or metals may be recovered from solution using any appropriate technique such as solvent extraction or ion exchange techniques.

10 BRIEF DESCRIPTION OF THE DRAWING

The invention is further described by way of example with reference to the accompanying drawing which is a flow chart representation of a method of recovering copper from a tailings dump, according to the invention.

15

DESCRIPTION OF PREFERRED EMBODIMENT

The accompanying flow chart illustrates a copper recovery process according to the invention.

20

The method of the invention applies particularly to the treatment of tailings which result from the grinding of copper ores followed by a flotation process. The tailings are usually pumped into a tailings pile. The particles in the tailings are fine and normally compact automatically to such an extent that penetration of air into the tailings dump is not possible
25 unless such penetration is assisted by external means.

In accordance with the invention a tailings pile 10, of the aforementioned kind, is adjusted in a step 12 to have a moisture content in the range of from 16% to 20% and preferably of the order of 18%. Thereafter, in a step 14, a surface layer of the tailings dump is

5 ploughed using mechanical means, to a depth of the order of from 0,5 to 1,0 metres. In this way the surface layer is loosened and aerated. The compaction density is effectively reduced. At the same time dilute sulphuric acid is added to the surface layer to adjust the pH thereof to a value in the range of from 1,3 to 2,0 (step 16). The surface layer may be ploughed several times to ensure that it has the correct pH and moisture content and to
10 ensure that such values are distributed substantially constantly throughout the surface layer.

Bacterial oxidation of the sulphide minerals in the surface layer is then allowed to take place for a controlled period the duration of which is dependent on a number of factors
15 including the mineral type and climatic conditions such as the temperature and the rainfall. For example with minerals such as chalcocite or bornite an oxidation period of the order of four weeks may be adequate. A longer period will be required for chalcopyrite. If the temperature of the dump rises due to climatic conditions this is normally regarded as being advantageous for the temperature increase encourages bacterial activity.

20

The moisture content of the dump may require adjustment, for example by means of sprinklers (step 18), but this step depends on the climate and rainfall or drying of the dump by low humidity conditions.

25 It is apparent that an objective of the invention in this regard is to create favourable conditions for bacterial oxidation of copper minerals in the upper layer of the dump to take place (step 20).

After the upper layer has been oxidised to the required extent mechanical equipment is

5 used to remove the oxidised material (step 22). Alternatively water guns or jets can remove the oxidised layer by sluicing or washing the material from the tailings dump. The reclaimed material is conveyed to agitated tanks where water 24, or an alternative suitable aqueous solution, possibly recycled from another part of the process, is added to form a slurry 26.

10

In the tanks copper dissolves into water forming an acid solution of copper sulphate and iron sulphate. In a separation step 28 the slurry is separated into solids and a solution by filtration or decantation techniques. The solids are washed in a step 30 and the liquid is added to the solution obtained by the separation step 28. The solids are then deposited on a new tailings dam (step 32).

15

The solution is subjected to a copper extraction step 34 using solvent extraction or ion exchange techniques.

20

Once the surface layer has been removed (step 22) in order to form the slurry the fresh upper surface layer of the tailings dump is treated in the described manner to provide aerated material with correct moisture and pH levels to establish favourable oxidation conditions. Sufficient oxidised material remains in the upper portion of the tailings pile to cause the pile to remain actively populated with bacteria.

25

It has been found that it is important to maintain the moisture content at about 18% although the content may vary from 16% to 20%. If the dump is too moist then air access is not possible. On the other hand if the dump is dry then bacterial action cannot take place effectively because migration of bacteria throughout the material is difficult.

CLAIMS

1. A method of recovering base metal from a tailings dump which includes the steps of:
 - (a) aerating a surface layer of the dump by agitating or mechanically loosening the surface layer;
 - (b) providing conditions favourable for bacterial oxidation of sulphide minerals by:
 - (1) adjusting the pH of the surface layer to a level in the range of from 1,3 to 2,0, and
 - (2) adjusting the moisture content of the surface layer to a value of from 16% to 20%;
 - (c) allowing bacterial oxidation to take place for a controlled period;
 - (d) after the controlled period removing the oxidised surface layer and adding water thereto to form a slurry;
 - (e) separating the slurry into solids and a solution; and
 - (f) recovering base metal from the solution.
2. A method according to claim 1 wherein the surface layer is aerated by ploughing the surface layer to a depth of between 0,5 to 1,0 metres.
3. A method according to claim 1 or 2 wherein the pH is adjusted by adding sulphuric acid to the surface layer.
4. A method according to any one of claims 1 to 3 wherein the said controlled period, in step (c), is at least four weeks.

5. A method according to any one of claims 1 to 4 wherein the oxidised surface layer is removed by at least one of the following: by mechanical means, and by the use of water jets.
6. A method according to any one of claims 1 to 5 wherein the slurry is directed to at least one tank in which agitation of the slurry takes place.
7. A method according to any one of claims 1 to 6 wherein base metal in sulphate form in solution is separated from the slurry.
8. A method according to any one of claims 1 to 7 wherein step (f) is carried out using solvent extraction or ion exchange techniques.
9. A method according to any one of claims 1 to 8 used for the recovery of copper from a tailings dump.
10. A method according to claim 9 wherein the tailings result from the grinding of copper ores followed by a flotation process.
11. A copper recovery process wherein copper ore is ground and then subjected to a flotation process which results in tailings which are transferred to a tailings pile, and wherein the tailings pile is subjected to the following: a surface layer of the pile is loosened and aerated, the pH of the surface layer is adjusted to a value in the range of from 1,3 to 2,0, the moisture content of the pile is adjusted to lie in a range of from 16% to 20%, and at least sulphide minerals in the surface layer are bacterially oxidised for a controlled period, whereafter the surface layer is

Printed:19-11-2001

CLMSPAMD

00962051-ZA0000155

INT100-0003R

3

ATT 24 AMO

removed, mixed with water to form a slurry which is conveyed to at least one agitation tank and, in the tank, the slurry is separated into solids and a solution from which copper is extracted using solvent extraction or ion exchange techniques.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau(43) International Publication Date
8 March 2001 (08.03.2001)

PCT

(10) International Publication Number
WO 01/16385 A1(51) International Patent Classification⁷: C22b 3/18, 15/00

(21) International Application Number: PCT/ZA00/00155

(22) International Filing Date: 31 August 2000 (31.08.2000)

(25) Filing Language: English

(26) Publication Language: English

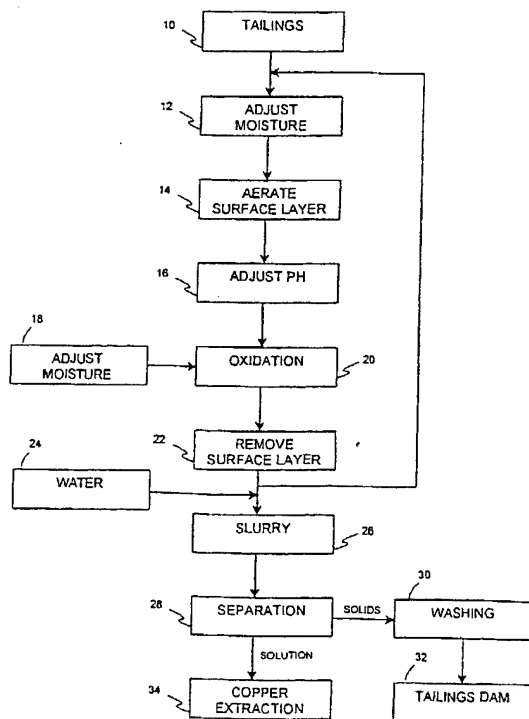
(30) Priority Data:
99/4274 1 September 1999 (01.09.1999) ZA(71) Applicant (for all designated States except US): BILLI-
TON SA LIMITED [ZA/ZA]; 6 Hollard Street, 2001 Jo-
hannesburg (ZA).

(72) Inventors; and

(75) Inventors/Applicants (for US only): CRAVEN, Peter,
Michael [ZA/ZA]; 6 Hollard Street, Johannesburg, 2001Johannesburg (ZA). TUNLEY, Trevor, Hugh [ZA/AU];
24 Aberfeldy Avenue, Edwardstown, S.A. 5039 (AU).(74) Agents: MCCALLUM RADEMEYER & FREIMOND
et al.; P.O. Box 1130, 7 Maclyn House, Bordeaux, 2125
Randburg (ZA).(81) Designated States (national): AE, AG, AL, AM, AT, AU,
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ,
DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR,
HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR,
LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ,
NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM,
TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.(84) Designated States (regional): ARIPO patent (GH, GM,
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian
patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European
patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE,
IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG,
CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: BASE METAL RECOVERY FROM A TAILINGS DUMP BY BACTERIAL OXIDATION

(57) Abstract: A method of recovering base metal from
a tailings dump which includes the steps of: aerating
a surface layer of the dump; adjusting the pH and the
moisture content of the surface layer to provide conditions
favourable for bacterial oxidation of sulphide minerals;
allowing bacterial oxidation to take place for a controlled
period; after the controlled period removing the oxidised
surface layer and adding water thereto to form a slurry;
separating the slurry into solids and a solution; and
recovering base metal from the solution.

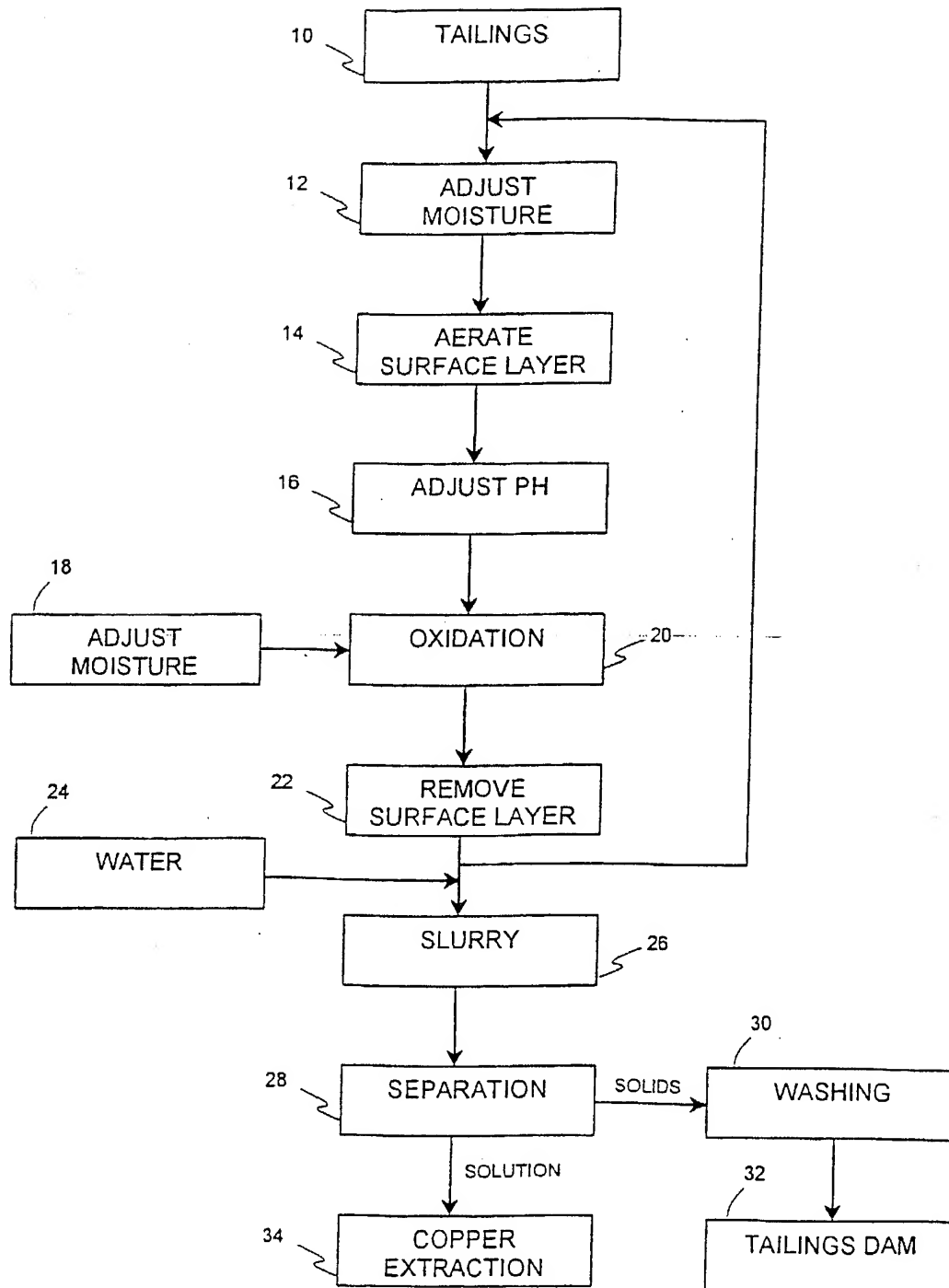
WO 01/16385 A1

WO 01/16385 A1

**Published:**

- With international search report.
- Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.



H4

COMBINED DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

This declaration is of the following type:

- ☐ original
- ☐ design
- ☐ supplemental
- ☒ national stage of PCT
- ☐ divisional
- ☐ continuation
- ☐ continuation-in-part (CIP)

My residence, post office address and citizenship are as stated next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed for and for which a patent is sought on the invention entitled:

Base Metal Recovery From a Tailings Dump by Bacterial Oxidation

the specification of which

- ☐ is attached hereto
- ☐ was filed on _____, as
Application No. _____
and was amended on _____
(if applicable)
- ☒ was described and claimed in PCT International Application No. ZA00/00155
filed on 31 Aug 2000 and as amended under PCT Article 19 on _____ (if any).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any Amendment referred to above.

I acknowledge duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

- ☐ In compliance with this duty there is attached an Information Disclosure Statement. 37 CFR 1.97.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119, of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

☐ no such applications have been filed
☒ such applications have been filed as follows.

Prior Foreign Application(s)

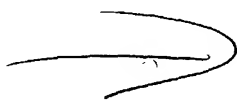
<u>99/4274</u>	<u>South Africa</u>	<u>01 September 1999</u>	<input checked="" type="checkbox"/> <input type="checkbox"/>
(Number)	(Country)	(day/month/year filed)	Yes No
 <u> </u>	 <u> </u>	 <u> </u>	 <input type="checkbox"/> <input type="checkbox"/>
(Number)	(Country)	(day/month/year filed)	Yes No

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

<u> </u>	<u> </u>
(Application Number)	(Filing Date)
 <u> </u>	 <u> </u>
(Application Number)	(Filing Date)

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below, and insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose all information known to be material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

<u> </u>	<u> </u>	<u> </u>
(Application No.)	(Filing Date)	(patented, pending, abandoned)
 <u> </u>	 <u> </u>	 <u> </u>
(Application No.)	(Filing Date)	(patented, pending, abandoned)



POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agents to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

George M. Cooper, Reg. No. 20,201
Felix J. D'Ambrosio, Reg. No. 25,721
William A. Blake, Reg. No. 30,548

Eric S. Spector, Reg. No. 22,495
Douglas R. Hanscom, Reg. No. 26,600
Jennifer P. Yancy, Reg. No. 47,003

(6)

Send correspondence to

Direct telephone calls to

Jennifer P. Yancy
JONES, TULLAR & COOPER, P.C.
P.O. Box 2266 Eads Station
Arlington, VA 22202

Jennifer P. Yancy
(703) 415-1500

I hereby declare all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor 1-00 CRAVEN, Peter Michael

Inventor's signature

X [Signature]

4 April 2002

(Date)

Residence Johannesburg, Republic of South Africa

Citizenship

X South African

ZAX

Post Office Address 6 Hollard Street, Johannesburg, 2001, Republic of South Africa

Full name of second joint inventor, if any 2-00 TUNLEY, Trevor Hugh

Inventor's signature

X [Signature]

8 APRIL 2002

(Date)

Residence Edwardstown, Australia

ALX

Citizenship

X SOUTH AFRICA

Post Office Address 24 Aberfeldy Avenue, Edwardstown, S.A. 5039, Australia